Sustainable Metal Roof for Pacific Rim Facilities

by Roch Ducey, Dave Bailey, and Roger Panzer

Corrosion-resistant roofs with integrated photovoltaic cells take advantage of two emerging technologies that provide both sustainable roofs and affordable electric power. Industry has developed innovative thin-film solar cell appliqués that can be installed on zinc-aluminum standing seam roof panels, which already have high performance anti-corrosion coatings applied, resulting in excellent corrosion protection characteristics. Together, the two technologies further enhance the non-corrosive properties of the metal roof system, while providing electrical power to the utility grid and thereby helping to offset facility energy costs.

This basic concept is being demonstrated on a replacement roof for Building 84 at Kilauea Military Camp, located inside Hawai'i Volcanoes National Park, in a partnership between the Con-struction Engineering Research Laboratory and the KMC directorate of public works. KMC is subject to a very harsh marine environment and highly corrosive gases from the nearby Kilauea Caldera. These operating conditions provide a worst-case scenario for testing the roof's structur-al integrity. In addition, electric rates in the Hawaiian Islands are among the highest in the na-tion, exceeding the cost of solar generated electricity.

Each thin-film, self-adhering solar power module was installed on its associated metal roof panel, with the wiring interconnects located at the ridge end of the panel.

The roof was installed and fully instrumented with corrosion detection sensors in early 2010. A ground-mounted test array was also installed to facilitate more convenient visual inspection. Corrosion monitoring has been ongoing since the replacement of the metal roof.

The 15-kilowatt peak solar power system was completed in late April and a post-construction meeting was held with Hawaiian Electric Company representatives to discuss the requirements for connecting the system to HELCO's grid. Interconnection of the solar power system is planned for June 2010, when a one-year performance monitoring period will begin.

Benefits

The current proof-of-concept demonstration being conducted at KMC will validate the projected benefits of these integrated technologies, i.e., enhanced survivability in corrosive marine environments, while producing electricity at lower costs than the high local utility rates. To one degree or another, these are the operational conditions experienced at most Department of Defense Pacific Rim facilities.

The combined unit was then installed on the roof joists.

In accordance with Office of Management and Budget Circular A-94 and using the required OMB spreadsheet, a return-on-investment of 18.5 was calculated for the current KMC non-corrosive solar roof demonstration project. The associated savings were $12,706,000. This ROI value was based on current best practices, as well as projected maintenance and rehabilitation practices and costs.

Another somewhat intangible benefit of this more sustainable non-corrosive solar roof system is the fact that a high percentage of DoD facilities in the Pacific Rim use their roofs as water cat-chment systems for the cost-effective, "green" production

of potable water. In this situation, the roof serves three functions: a long-lasting, corrosion-resistant shelter for the building; an onsite power source that helps reduce utility costs and improve energy security; and the source for pro-ducing potable water.

Future Proposed Efforts

This system-of-systems integration project required applying, at the construction site, a commer-cial-off-the-shelf thin-film solar product to the standing seam metal roof with anti-corrosion coatings. Though this two-step construction approach is likely to prove successful in supplying a cost-effective durable multi-functional roofing system, the development of a process that integrates the two technologies at the manufacturing plant would greatly lower both initial capital costs and life-cycle costs. It is estimated that a one-step manufacturing process would improve the economic factors by as much as 25 percent, making them even more attractive for widespread implementation at DoD facilities throughout the Pacific Rim. And ultimately, these systems may become economically viable for mainland facilities, as well.

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